Sediment transfer by rills and ephemeral gullies at the microcatchment scale: a study case to evaluate the impact of rainfall variability and management in a semi-intensive olive orchard in Spain

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Erosion associated with concentrated flow in Mediterranean cultivated areas is considered as a major process of land degradation. In this work, the features of rills and ephemeral gullies generated in an olive orchard catchment of 6.4 ha, where tillage operations were usually applied, were measured and compared with sediment loads at the catchment outlet. The specific objectives were: 1) to quantify the rills and ephemeral gullies measured in the catchment for inter-tillage periods where different hydrological features (precipitation and erosivity) and management schemes were observed; and 2) to assess the contribution of concentrated flow to measured sediment discharge at the catchment outlet by considering the impact of cover crop strips during the last period.

The cross-sectional measurements of depth, width, shape, length and location of rills and ephemeral gullies in the catchment were carried out through a GPS survey. Each were measured 4 times between April 2009 and March 2014. During the first three campaigns, the management was conventional tillage; however, in September 2014, cover crops (Bromus rubens L.) were seeded in some lanes of the catchment following the most approximate contour direction. A gauge station with a flume at the catchment outlet captured rainfall, runoff and sediment discharge measurements.

The quantitative and statistical analyses consisted of evaluating and correlating the hydrological features associated with the measurement period (cumulative erosivity and precipitation, number of erosive events with maximum intensity of 10 minutes and the corresponding return period) with the rills and ephemeral gullies generated (number, total volume and length, shape and mean length, width and depth) and the total runoff and sediment loads in the catchment.

The mean volume of rills and ephemeral gullies for the 4 surveys was equivalent to 8.1 t·ha-1 and 3.3 t·ha-1, respectively; whereas, the mean total sediment discharge for the same period was of 9.5 t.ha-1. Soil losses associated with the rills only showed an acceptable correlation with 10 minute maximum intensity, ranging between 1 and 20 t·ha-1. The impact of cover crops during 2014 was particularly notable on rill discontinuity and sediment trapping as observed in the field; however, few erosive events happened during the period. Active sediment dynamics are expected in the catchment, derived from a sequence of events with high precipitation (not particularly intense), which improve the connectivity of rills generated in the lanes to the stream. Despite the reduction of rill connectivity and sediment discharge due to the use of a cover crop, the farmer decided not to maintain it because of management inconveniences.